# ENERGY EFFICIENT COMPACT OIL AND WATER SEPARATOR

## FIELD OF THE INVENTION

This invention relates to oil and water separators, particularly those incorporating gravity separation to separate the water from the oil.

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## BACKGROUND OF THE INVENTION

My patents number 5865992 and 5902493, Buchanan 6207032 and Bull 6315898 all describe methods and/or apparatuses used to separate water from flowing oil and while each of these teach ways and means to efficiently employ enhanced gravity separation utilizing horizontal containment vessels and to compensate, to some degree, for varying total flow rates within the vessel none addresses the fact that the water and oil generally flow at different flow rates with variations in density and viscosity. Further, both the Buchanan and Bull inventions employ means for adjusting flow areas within the vessels, whereby the flow area is adjusted for either the flow rate of the oil or the flow rate of the water but not discreetly for both. The Buchanan and Bull patents employ a horizontal flow direction through the electric field when the electric field is employed, utilizing electrified and/or grounded grids that are positioned vertically with the lower edge of the electrified grids being above the oil/water interface to prevent electrical short circuiting of the electrified grid to the water phase. This arrangement exposes a flow path beneath the grids whereby a substantial quantity of the oil may pass without contacting the electric field. As the water separates from the oil within the horizontal flow path and settles into the water phase, the water content can become concentrated in the electric field immediately above the oil/water interface to the extent that electrical short circuiting may occur.

If heating is necessary to enhance the oil and water separation both the Buchanan and Bull inventions employ long U tube fireboxes with low overall fuel efficiency.

The deficiencies of the prior inventions require that the size of the containment vessels be increased to compensate for the inefficiency and also in the case of the Buchanan and Bull inventions more fuel will be consumed when heating is required.

As it is becoming necessary to explore and produce petroleum from more remote locations, often "water bound", it is becoming important to reduce the "footprint" of the oil and water separators. Therefore it is essential to devise means and methods for improving the performance efficiency of oil and water separators. Accordingly my invention improves the method and apparatus to the extent that for any given flow rate the containment vessel can be made smaller and when heating is required, less fuel will be consumed than with prior inventions.

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## SUMMARY

Through the implementation of precise hydrodynamics control and unique efficient heating means this invention reduces the containment vessel size and saves fuel. It overcomes the problem of some oil bypassing the electric field, water accumulation and electrical short circuiting in the electric field by incorporation of a novel structure that imparts a downward flow direction through the electric field. Residence time of the fluid within the vessel is maximized by eliminating hydraulic short circuiting through the employment of permeable barriers whereupon the permeability is discreetly adjustable to compensate for variations of flow rate, density and viscosity of the fluids being processed and overall fuel efficiency is improved and firetube length reduced by utilizing a multi-tube heat exchange segment on the U tube.

# ENERGY EFFICIENT COMPACT OIL AND GAS SEPARATOR

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1. is a side view schematic drawing showing all of the elements of the preferred embodiment of the invention.

View AA. is a cross section of the heating element showing the multitube section on the exhaust side of the U tube.

View BB. is from above the permeable barrier transverse to the flow path diversion structure.

View CC. is a cross section of the permeable barriers transverse to the oil and water flow paths downstream of the flow path diversion structure.

Figure 2. is a schematic illustration of the external manipulator as an indicator of the angular direction of the louvers.

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## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings there is disclosed an energy efficient compact oil and water separator wherein water will be extracted from oil and oil extracted from water, employing a unique array of novel structures that cause the extraction of the water and oil to be more complete and efficient than with prior inventions.

A mixture of oil and water enter the containment vessel 1 through the inlet conduit 2 impacting a deflector means 2a to impede the momentum of the entering mixture. Oil will migrate to an upper region 1a of the containment vessel and the water will migrate to a lower region 1b. The objective is to have water free oil exit the oil outlet conduit 3 and oil free water exit the water outlet conduit 4 with the minimum expenditure of time and energy.

To accomplish this objective it is usually necessary to heat the oil to lower the viscosity. With my invention this is accomplished utilizing a U shaped firetube that has a burner 5c on one end and an exhaust stack 5b on the other end and includes a novel multitube heat exchange section 5a on the exhaust side of the U tube to increase the surface area of the firetube and thus improve the heat exchange efficiency while decreasing the physical size of the firetube and the burner.

After the oil viscosity reduction it is common to pass the oil through an electric field to coalesce the entrained water drops for faster gravity separation. With my invention this is more efficiently accomplished by causing the oil to flow downward through the electric field 15 rather than horizontally or upward as with prior inventions. The downward flow will purge the coalesced water drops from the electric field preventing the concentration of water in the electric field from becoming high enough to cause electrical short circuiting.

A flow diversion structure is formed by solid baffle 6 which has its upper edge below the vapor/oil interface and its lower edge below the oil/water interface and solid baffle 7 which has its upper edge above the vapor/oil interface and its lower edge above the oil/water interface. To further enhance the effectiveness of the downward flow there are permeable barriers 8 and 9 transverse to the space within the flow diversion structure to implement a vertical plug flow through the flow diversion structure. The permeability of the permeable barriers shall be discretely variable to compensate for differences in flow rate, density and viscosity.

As opposed to the prior inventions where the oil might exit the vessel immediately upon departing the electric field my invention incorporates a second stage of water drop coalescing and gravity separation in the aft region 1c of the containment vessel. The space for the second stage of coalescing and gravity separation is afforded by the compactness of the electric field 15 of my invention which is permitted by the downward flow through the electric field enhanced by the application of the permeable barriers.

The second stage of coalescing and gravity separation is formed by capillary coalescing baffle 10 as described by my patent 5902483 and permeable barrier 11 transverse to the oil flow path and permeable barrier 12 transverse to the water flow path each having its permeability discretely variable to compensate for differences in flow rate, density and viscosity.

Fig. 2 is a schematic detail illustrating one type of structure that can be utilized to provide discretely variable permeability of the permeable barriers. In this embodiment of my invention the permeable barrier will be in the form of a louvered shutter with rotatable louvers. Item 14 represents a rotatable louver connected to rotatable shaft 13a that penetrates the containment vessel wall and to which a handle 13 is externally connected. There shall be a packing gland (not shown) that seals the containment vessel at the point of shaft penetration. The rotatable

louver is connected to other rotatable louvers by a connecting rod 16 in such a manner that a series of louvers will be rotated at the same time. The handle will be attached to the rotatable shaft so that its angular direction corresponds to the angular position of the louvers.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and within the scope of the appended claims. It can be readily seen that the objectives and advantages are realized as disclosed by this specification and will be even further understood as described by the appended claims.